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Response of Two Sunflower (*Helianthus annuus* L.) Cultivars To Different Levels of Nitrogen

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Abstract

Response of two sunflower cultivars namely Aritar-93 and suncom-110 to N levels of 0, 50, 100 and 150 kg ha^{-1} was studied under field conditions. Sunflower cultivar suncom-110 produced significantly higher plant height, leaf area per plant, 1000-achene weight and achene yield. Plant height, leaf per plant, stem diameter, no. of achenes per disc and achene protein contents were maximum at N level of 150 kg ha^{-1}. Whereas, oil contents were significantly higher in control. Nitrogen application at 100 and 150 kg ha^{-1} gave statistically similar achene yields of 15.95 and 16.18 q ha^{-1} respectively. Application of nitrogen more than 100 kg ha^{-1} seems to be uneconomical.

Key words: *Helianthus annuus* L., cultivars, nitrogen levels, yield, oil contents, protein contents

Introduction

Fertilizer application is one of the major factors which could increase sunflower production on per unit basis. Among the fertilizer nutrients applied, nitrogen is being used more extensively than the other fertilizer (Anonymous, 1992). Judicious use of nitrogen will help in increasing per hectare yield of sunflower (Bindra and Kharwara, 1992). Sharma and Gaur (1988) observed that the application of N at the rate of 30, 60 and 90 kg ha^{-1} to sunflower, gave seed yields of 1.80, 2.08 and 2.28 t ha^{-1} with seed oil contents of 42.99, 41.95 and 40.49% and protein contents of 17.17, 18.11 and 18.15 percent, respectively. Kasem and El-Mesilby (1992) studied the effect of 0, 50, 100 and 150 kg N ha^{-1} on sunflower and they found that N increased the leaf area, 1000-seed weight and seed yield per head. The seed yield per hectare was highest with 150 kg ha^{-1} N. Seed oil contents were decreased and seed protein contents increased by applied N. Patil *et al*. (1992) found that sunflower cv. LSH-3 when given 0, 40, 80 and 120 kg ha^{-1} N, produced seed yields of 1.41, 1.50, 1.59 and 1.64 t ha^{-1}, respectively. The corresponding oil yields were 0.74, 0.53, 0.56 and 0.55 t ha^{-1}. Bhalerao *et al*. (1993) concluded that seed yield of sunflower cv. BSH-I, KBSH-1 and MSFH-8 increased with application of N upto 60 kg ha^{-1}. Khorkhani *et al*. (1993) worked on sunflower cv. 68414 and found that seed yield increased with increasing N application upto 100 kg ha^{-1}. Jaybhaye and Jadhav (1992) and Manoharan *et al*. (1991) have also reported increase in seed yield of sunflower with the application of nitrogen fertilizer. However, the effect of nitrogen application on the oil contents of sunflower seed is some what controversial. Kamel *et al*. (1980) reported that nitrogen application did not affect the oil content of sunflower seed either way. On the other hand, Blamey and Chapman (1981) and Kasem and El-Mesilby (1992) observed that increased doses of N application decreased the oil contents of sunflower seed. Similar results were also reported by Nazir *et al*. (1986), but Steer *et al*. (1986) and Manoharan *et al*. (1991) reported that oil contents of sunflower seed were increased by N fertilizer. Singh *et al*. 1986) reported that protein contents increased with increasing the fertilizer rates, while on the other hand oil contents decreased significantly.

This study was therefore proposed to determine the effect of varying doses of nitrogen on the growth, yield and oil contents of two sunflower cultivars, so that necessary recommendations could be made under Faisalabad conditions.

Materials and Methods

Experiment was conducted on a sandy clay loam soil having 0.081 percent N, 7.42 ppm available P and 224 ppm K. The experiment was laid out in a randomized complete block design with four replications and plot size of 6 x 3 m. The crop was sown with the help of a single row hand drill in 60 cm apart rows. Two sunflower varieties Aritar-93 and suncom-110 were fertilized at rates of 0, 50, 100 and 150 kg N ha^{-1} in sub-plots. Phosphorus was applied at, 75 kg ha^{-1}.

Whole of P and half of N was side drilled immediately after seeding, while remaining half of N was applied at flowering. Interplant distance of 22 cm was maintained by thinning at 5-6 leaf stage. The crop was earthed up after 3rd irrigation to prevent lodging. Two hand hoeing were also given to keep the crop free of weeds. Five plants were selected at random from each plot to record plant height, stem diameter, leaf area per plant at flowering and no of achenes per head. The protein contents of seed were determined by using Gunning and Hibbard's method of H_2SO_4 digestion and using Microkjeldhal method for distillation (Jackson, 1962). Achene oil contents were determined as suggested by AOAC (1984). The data was analysed by using Fisher's analysis of variance technique and treatments means were compared by least significance difference test at 5 percent probability level (Steel and Torrie, 1984).

Results and Discussion

Significant differences were observed among the various treatments under study for plant height taken at maturity (Table 1). The variety sumcom-110 significantly produced taller plants (188.37 cm) than Aritar-93 (171.97), These differences can be attributed to differences in genetic makeup of the variety, The suncom-110 might be a long stature variety. The application of nitrogen at the rate of 150 kg ha^{-1} produced taller plants (189.30 cm), followed by 50 and 100 kg nitrogen per hectare, producing 184.80 cm and 184.35 cm tall plants respectively. However, the differences between 50, 100 and 150 kg N ha^{-1} were not significant. Minimum plant height (160.85) was observed in case of control. Kasem and El-Mesilby (1992) have also reported that application of nitrogen upto 150 kg ha^{-1} increased plant height over control.

Leaf area per plant at flowering between varieties showed significant differences (Table 1). Variety suncom-110 gave higher leaf area (3269.68 cm^2) than Aritar-93 (3078.50 cm^2). Application of N at 150 kg ha produced significantly higher leaf area per plant (441 6.00 cm^2) than other N levels.This treatment was followed by 100 kg ha^{-1} N (3420.00 cm^2). Minimum leaf area per plant (2196.12 cm^2) was observed in plots where no N was applied. More leaf area in suncom-1 10 could be varietal character. High N rates produced more leaf area per plant due to more assimilates production and their utilization towards leaf expansion. Similar results were reported by Kasem and El-Mesilby (1992).

Stem diameter was statistically similar of both the varieties and values recorded were 5.22 cm and 5.48 cm for Aritar and Suncom, respectively (Table 1). All nitrogen levels (50, 100, 150 kg) have statistically similar stem diameter but was significantly higher than control. Maximum (5.88 cm) and minimum (4.12 cm) stem diameter was produced by 150 kg N ha^{-1} and control, respectively. Increase in stem diameter with nitrogen application have also been reported by Kasem and El-Mesilby (1992).

Both the sunflower cultivars produced statistically similar no. of achenes per disc (Table 1). The maximum number of achenes per disc (1004.40) was recorded for cultivar suncom-110. Similar number of achenes per disc may be due to the reason that both cultivars have similar potential for number of achenes per disc. Non-significant differences for number of achenes per disc amongst varieties have also been reported by Nayak and Ghose (1990). The plots receiving no nitrogen produced significantly lowest no of achenes per disc (805.37). The plots receiving 150 kg N ha^{-1} gave maximum no. of achenes per disc (1115.90) but was statistically similar to 100 and 50 kg ha^{-1} N, which produced 1034.32 and 1015.77 achenes per disc, respectively. The increase in number of achenes per disc with nitrogen application have also been reported by Kamel *et al*. (1980). The data presented in Table 1 showed that suncom-110 produced significantly higher 1000-achene weight (55.75 g) than Aritar-93 (40.32 g). These results confirm the work reported by Singh *et al*. (1987). 1000 achene weight was not influenced to significant extent with nitrogen but it increased with increasing nitrogen rate from 41.08 g in control to 53.98 g with the application of 150 kg N ha^{-1}. Increase in 1000-achene weight with nitrogen application have also been reported by Kamel *et al*. (1980). Achene yield was significantly affected by cultivars and N levels (Table 2). Cultivar suncom-110 gave significantly higher achene yield of 14.94 q ha^{-1} than cultivar Aritar-93, which yielded 12.77 q ha^{-1}. Similarly Ahmad (1993) have

Table 1: Effect of N levels on plant height, leaf area $plant^{-1}$ (cm^2), stem diameter, no. of achenes $disc^{-1}$ and 1000-achene weight of two sunflower cultivars

	Plant height (cm)	Leaf area $plant^{-1}$	Stem diameter	No. of achene $Disc^{-1}$	1000-achene weight
Cultivars					
Aritar-93	171.97b	3078.50b	5.22^{NS}	981.28^{NS}	40.32b
Suncom-110	188.37a	3269.68a	5.48	1004.40	55.75a
N levels kg ha^{-1}					
0	160.85b	2196.12d	4.12b	805.37b	41.06^{NS}
50	184.80a	2665.25c	5.44a	1015.77a	48.09
100	184.35a	3420.00b	5.47a	1034.32a	48.98
150	189.30a	4416.00a	5.88a	1115.90a	53.98

Table 2: Effect of N levels on achene yield, achene oil content and achene protein content of two sunflower cultivars

	Achene yield (q ha^{-1})	Achene oil content (%)	Achene protein content (%)
Cultivars			
Aritar-93	12.77b	46.48^{NS}	24.78^{NS}
Suncom110	14.94a	44.59	24.36
N levels kg ha^{-1}			
0	9.46d	49.48a	22.38d
50	13.22c	45.00b	23.82c
100	15.95a	43.03b	25.11b
150	16.18a	43.85b	26.96a

Any two means not sharing a letter in column, differ significantly ($p < 0.05$)

also reported that cultivar C-206 gave significantly higher yield (3.31 t ha^{-1}) than cultivar SF-100, which yield 2.67 t ha^{-1}. The crop fertilized at 150 kg N ha^{-1} gave higher achene yield of 16.18 q ha^{-1} and was followed by 100 kg N ha^{-1} which gave achene yield of 15.95 q ha^{-1}. However, they were statistically similar with each other. Significantly lowest achene yield (9.46 q ha^{-1}) was observed in case of control. High yield in suncom-110 might be due to higher achene weight per disc and 1000-achene weight. Minimum achene yield in case of control could be attributed to lowest no of achene per disc. These results are supported by findings of Kasem and El-Mesilby (1992) and Patil *et al*. (1992).

Both the varieties were statistically similar in respect of achene oil and protein contents (Table 2). The results are contradictory to those of Ahmad (1993) who observed significant differences between the varieties both for achene oil and protein contents. These contradictory results may be due to the different genetic make up of the varieties or different climatic conditions prevailing during the growth period of the crop. Plots receiving no. N resulted in significantly higher achene oil contents (49.48%). Plots fertilized with 50, 100 and 150 kg ha^{-1} N were statistically similar in respect of achene oil contents. There was linear increase in achene protein contents with increase in N rates. Nitrogen application at 150 kg ha^{-1} resulted in significantly higher achene protein contents (26.96%) followed by 100 kg N ha^{-1}.

The decrease in achene oil contents might have been due to more water uptake, which might have resulted in dilution of oil contents. Increase in the achene protein contents with the increase in N rates might have been due to the reason that nitrogen application have enhanced the amino acid formation. The results confirm the findings of Kasem and El-Mesilby (1992) and Patil *et al*. (1992).

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